ACCOUNTING THE DYNAMIC PROPERTIES OF MATERIAL AT TECHNOLOGICAL PROCESSES OF HIGH-RATE DEFORMATION

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ABSTRACT
The dynamic behavior of materials at high-rate deformation under the action of short-term loads is studied. These properties are used for solving the problem by the finite element method. The research results enable us to give practical recommendations on the definition of rational parameters of technological processes and increase the dynamic strength of protective structural elements.

Keywords: impact, high rate deformation, dynamic properties of material, FEM.

INTRODUCTION
Comprehensive research on high-speed deformation of structural components is not possible without experimental data on the dynamic properties of the material, which represent relationships between the stresses, intensities strains and strain rates (Meyers, 1994). Experimental studies are also needed to verify the results of numerical studies of new models and methods that are become more complex. The problem is solved by the finite element method, which takes into account the specifics of the process.

The linear flat and cylindrical specimens are used for experimental studies of dynamic properties of materials. A feature of the installation is the simultaneous deformation of the samples with the rod-dynamometer.

The rod-dynamometer is designed so, that it is deformed in the elastic stage, when the sample undergoes the elasto-plastic deformations until to destruction. Inertialess strain gauges at the same time determine the deformation of the sample and the rod. This data is used to determine the dynamic properties of materials. These relationships are determined without regard to the preliminary assumptions on the deformation of the samples at a constant rate. The corresponding graphs confirm the change of the deformation rate during the experiment (Vorobiov, 1989).

Therefore, the dynamic properties are applicable to the large strains up to the destruction of the material.

The zone of development of the intensive stresses is very limited at impact load. Therefore, as a result of numerical analysis when we identify zone of intensive stresses, we can allocate area of the structural element of interest. A denser mesh of finite elements can be used in this area (Vorobiov, 2016).
Using the results of numerical and experimental studies it is possible to determine the parameters of various technological processes, such as formation by means of a high-rate punching, and connection of elements, such as explosion welding.

RESULTS AND CONCLUSIONS

Also, the impact of projectiles on the multi-layered elements of different materials considers. The action of the projectile on the element of two thin layers of titanium alloy and a ceramic inner layer are shown in Fig. 1.

![Fig. 1 - Deformations (a) and the equivalent stresses (b) in a three-layer element under the action of the projectile at speeds of 400 m/s through 3·10⁴ after contact](image)

We can see the damage of the first layer of titanium alloy and the crater formation. In the inner ceramic layer the most extensive areas of deformations arise, which helps to absorb impact energy. In this case the three-layer element retains its protective properties.

The research results enable us to give practical recommendations on the definition of rational parameters of technological processes, reduce the level of dynamic stresses and increase the dynamic strength of the protective elements of constructions.

REFERENCES

